

3) $\text{C}_6\text{H}_5\text{NH}_2 + \text{H}_2\text{O} \rightleftharpoons \text{C}_6\text{H}_5\text{NH}_3^+ + \text{OH}^-$

I	0.10 M	0	0
C	-x	+x	+x
E	0.10-x	x	x

$\text{pH} = 8.82 \therefore \text{pOH} = 14 - 8.82 = 5.18$
 $\therefore [\text{OH}^-] = 10^{-5.18} = 6.61 \times 10^{-6} \text{ M}$

$$K_b = \frac{[\text{OH}^-][\text{C}_6\text{H}_5\text{NH}_3^+]}{[\text{C}_6\text{H}_5\text{NH}_2]} = \frac{(6.61 \times 10^{-6})^2}{0.10 - 6.61 \times 10^{-6}} = 4.4 \times 10^{-11}$$

4) $\text{HF} + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{F}^-$

I	0.44	0	0
C	-x	+x	+x
E	0.44-x	x	x

Check: $\frac{0.44}{1000} \approx 0.44$ use approximation method.
 $\therefore 0.44-x \approx 0.44$
 $K_a = \frac{[\text{H}_3\text{O}^+][\text{F}^-]}{[\text{HF}]} = 7.2 \times 10^{-4} = \frac{x^2}{0.44}$
 $x = 0.0177 \text{ M}$
 $\text{pH} = -\log(0.0177) = 1.75$

5) $\text{Mg}(\text{OH})_2 \rightleftharpoons \text{Mg}^{2+} + 2\text{OH}^-$

I	0	0	0
C	+x	+2x	
E	x	2x	

$$K_{sp} = [\text{Mg}^{2+}][\text{OH}^-]^2 = (x)(2x)^2 = 4x^3$$

Solubility $x = \text{mol/L}$
 $\frac{7.6 \text{ mg}}{\text{L}} = \frac{10^{-3} \text{ g}}{1 \text{ mg}} \times \frac{1 \text{ mol}}{58.3 \text{ g}} = 1.30 \times 10^{-4} \text{ mol/L}$
 $K_{sp} = 4(1.30 \times 10^{-4})^3 = 8.9 \times 10^{-12}$

6) $\text{NaOOCN} \rightleftharpoons \text{Na}^+ + \text{OCN}^-$

$\text{OCN}^- + \text{H}_2\text{O} \rightleftharpoons \text{HOCN} + \text{OH}^-$
 $\text{HOCN} + \text{NaOH} \rightarrow \text{H}_2\text{O} + \text{NaOCN}$

I	0.010 M	0.010 M	0
C	-x	-x	+x
E	0.010-x	0.010-x	x

$K_b = \frac{K_w}{K_a} = \frac{10^{-14}}{3.5 \times 10^{-4}} = 2.857 \times 10^{-11}$
 $2.857 \times 10^{-11} = \frac{x^2}{(0.010-x)^2}$
 $x = 4.63 \times 10^{-3} \text{ M}$
 $\text{pH} = -\log(4.63 \times 10^{-3}) = 2.33$
 $\text{pOH} = 14 - 2.33 = 11.67$
 $\text{pH} = 7.67$ at equivalence

7) $\text{Ag}_2\text{CO}_3 \rightleftharpoons 2\text{Ag}^+ + \text{CO}_3^{2-}$

I	0.010 M	0	0
C	-2x	+2x	+x
E	0.010-2x	2x	x

$K_{sp} = [\text{Ag}^+]^2[\text{CO}_3^{2-}] = (2x)^2(x) = 4x^3$
 $2.5 \times 10^{-12} = 4x^3$
 $x = 1.286 \times 10^{-4} \text{ mol/L}$

8) $\text{HCl} + \text{NaHCO}_3 \rightarrow \text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$

I	0.010 M	0.010 M	0
C	-x	-x	+x
E	0.010-x	0.010-x	x

$\text{pH} = -\log(0.010-x) = 1.97$

	NaOH	CH ₃ COOH	
C	0.45 M	0.35 M	
V	0.025 L	0.021 L	total V = 0.046 L
n	0.01125 mol	$0.021 \times 0.35 = 0.00735 \text{ mol}$	

$$n_{\text{NaOH (unreacted)}} = 0.01125 - 0.00735 = 0.0039 \text{ mol}$$

$$C_{\text{NaOH after adding 21 mL acid}} = \frac{0.0039 \text{ mol}}{0.046 \text{ L}} = 0.0848 \text{ mol/L}$$

$$\text{pOH} = -\log 0.0848 = 1.07$$

$$\text{pH} = 14 - 1.07 = 12.93$$